Chapter 44
Pregnancy and Bariatric Surgery

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Introduction

Utilization of bariatric surgery has increased substantially over the past few decades, notably among women of childbearing age. The incidence of bariatric surgery increased 800% between 1998 and 2005, with 83% of patients between ages 18 and 45 being female [1]. It is well known that obesity is a risk factor for infertility, and many women seeking bariatric surgery do so with the goal that weight loss will result in future pregnancies. However, data on pregnancy outcomes following bariatric surgery are mostly from retrospective, observational studies.

Most surgeons advise patients to wait at least 12–24 months following bariatric surgery before pursuing a planned pregnancy. This is largely due to unstable nutritional needs immediately postoperatively, the risk for intrauterine growth retardation, and the decrease in total body weight lost from bariatric surgery [2, 3]. However, many pregnancies are unplanned, and there may be consequences in those patients who become pregnant soon after weight loss surgery.

Obesity, Pregnancy, and Infertility

Obesity during pregnancy is a risk factor for miscarriage, fetal anomalies, macrosomia, preeclampsia, gestational diabetes, venous thrombosis, need for cesarean section, and postpartum hemorrhage [4]. Obesity is also an independent risk factor for reduced fertility, with OR 0.92 for overweight women and OR 0.82 for obese women [5]. One study found that 40.4% of obese women have abnormal menstrual

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cycles, with infertility in 29.3% [6]. Polycystic ovarian syndrome (PCOS) is intricately linked to obesity and insulin resistance, which can result in anovulation. Even in obese women with normal menstrual cycles, fertility is reduced [5].

Weight loss can result in resolution of anovulation and subsequent pregnancy [7]. This has also been demonstrated with weight loss from bariatric surgery [8]. For these reasons, many women of childbearing age who are obese turn to bariatric surgery for assistance with obtaining and maintaining a healthy pregnancy.

Pregnancy Following Lap Band

Compared to obese women without an adjustable gastric band (AGB), women with AGB have a lower risk of gestational diabetes and hypertension, cesarean section rates, fetal macrosomia, and preeclampsia [9].

In some patients, presence of AGB can cause mechanical complications requiring intervention. Band slippage is a known complication of AGB that can occur at any time, though some speculate that the risk may be increased during the peripartum time period. Theories regarding peripartum band slippage include the vertical displacement of the AGB due to intra-abdominal pressure and girth [10], use of the Valsalva maneuver during vaginal labor, and hormonal changes that may result in laxity of ligamentous attachments [11]. Carelli found that 3 of 133 pregnancies were complicated by band slippage, with one requiring surgical removal of the AGB during pregnancy [11]. Band slippage during pregnancy can be diagnosed by plain abdominal radiograph, with observation for the "O" sign and presence of an enlarged gastric bubble superior to the AGB, indicating downward displacement of the AGB into a horizontal position. If needed, a gastrografin swallow study can be performed for confirmation, with careful shielding of the uterus [12].

Rare complications such as AGB erosion, gastric torsion, and gastric rupture have been reported during pregnancy [13, 14].

Management of AGB balloon volume during pregnancy is controversial. Some surgeons advocate for full AGB deflation to theoretically lessen the risk of band slippage, while others will only empty the AGB based on the patient's symptoms of nausea and vomiting [10, 15]. Carelli found that 71% of pregnant patients underwent AGB adjustment at some point during pregnancy, usually based on symptoms of nausea or vomiting. In patients whose AGB was fully or partially deflated, weight gain was higher during pregnancy, especially if the AGB was emptied during the first trimester [11]. Cornthwaite and colleagues found that women who had the AGB deflated during pregnancy gained more weight, had an increased risk of gestational hypertension, and had a higher risk of fetal macrosomia [16].

Pregnancy Following Sleeve Gastrectomy

Sleeve gastrectomy (SG) has now become the most common bariatric surgery being performed in the United States [17]. Outcomes regarding pregnancy and the perinatal period following SG are limited, given its recent development as a stand-alone operation. One theoretical concern is the potential for vitamin B12 deficiency, as the portion of stomach resected generates intrinsic factor necessary for its absorption. Protein deficiency can also be present from inadequate oral intake [18]. An additional concern is the incidence of newborns that are small for gestational age (SGA), which has been inconsistently reported for SG.

One study in France, employing a prospectively maintained database, evaluated 63 pregnancies in 54 women who had undergone SG. Women who conceived within 1 year of undergoing SG had a higher, but not significant, rate of transfer of their newborn to a neonatal intensive care unit [19]. There were no significant rates of low birth weight (LBW) or incidence of SGA. The authors also noted that patients who became pregnant within a year after SG gained less weight than their counterparts who became pregnant after 1 year. In Korea, 12 patients who became pregnant after SG were followed and evaluated. The authors observed no congenital abnormalities or deaths. There were no apparent complications identified in their small group of patients [20].

A comparative study performed in Greece focused on nutritional aspects with respect to pregnancy outcomes. The authors' study demonstrated significant declines in vitamin B12 when compared to before and during pregnancy [21]. Their patients received routine intramuscular injections of vitamin B12 to remove compliance as a confounding variable. With respect to newborn outcomes, there were no increased rates of SGA or LBW observed with SG. They did observe a statistically significant decline in serum albumin from the post-surgery state to pregnancy (4.33 ± 0.38 vs. 4.02 ± 0.39 g/dL; $p = 0.038$). Although the level is still acceptable, its decline is noteworthy. This study suggests that close monitoring of protein, vitamin, and mineral status before and during pregnancy is important, even in SG.

In summary, the perinatal outcomes after SG are largely unknown, and further study is warranted. Given the unknown, it is likely best to follow a conservative approach, recommending avoidance of pregnancy for 2 years, and prenatal evaluation by the bariatric surgery team before initiating pregnancy. In this manner, vitamin levels can be appropriately evaluated and optimized to avoid any deficiencies.

Pregnancy Following Gastric Bypass

The Roux-en-Y gastric bypass (RYGB) was the most common weight loss operation until recently [17], and it has shown clear benefits in improving fertility. There is also documented improvement in gestational diabetes, preeclampsia, stillbirths, Apgar scores, macrosomia, and caesarian section [22–24]. However, the

malabsorptive component of the operation can cause problems during pregnancy. Supplementation of protein, vitamins, and minerals are mandatory to prevent deficiencies which can be significant and sometimes life-threatening. These are well documented in the literature [25–28]. RYGB can have significant effects on both the mother and fetus, along with peripartum complications.

Several studies have shown a link between RYGB and SGA status of the newborn baby [29–32]. A multicenter study from Spain documented a 12.7% rate of SGA among RYGB patients [29]. The authors performed a logistic regression analysis, and only the RYGB and other malabsorptive procedures were risk factors. BMI, maternal age, and time from surgery to pregnancy were not significant factors. Similarly, Kjaer and colleagues identified a 7.7% rate of SGA newborns among RYGB patients [30]. Comparing with matched controls, there was an adjusted OR of 2.8 for SGA after RYGB. They showed no difference in APGAR score < 7, need for NICU admission, or perinatal death as a result of RYGB. Norgaard and colleagues found a higher rate of SGA at 18.8%. There was no statistical difference in SGA rate in patients who became pregnant before or after 18 months post-RYGB [31]. A Danish national cohort study evaluated outcomes in women after RYGB and compared them to matched obese controls. The authors found a higher rate of SGA, a higher need for neonatal intensive care units, and higher rate of illness in the neonatal period requiring hospitalization. They did not find a difference in congenital malformations [32]. The RYGB patients did, however, have a higher risk for acute abdominal pain during pregnancy (RR 6.4).

RYGB patients often have vitamin and mineral deficiencies. These are largely due to a combination of dietary habits, non-compliance with supplementation, and poor follow-up. Commonly encountered deficiencies include vitamin B12, which is seen in low levels in 30–70% of patients. Iron deficiency anemia (20–49%) and folate deficiency (9–18%) are also seen after RYGB [33]. Low levels of vitamin D can be seen in as many as 55–66% of post-RYGB patients [34]. These factors increase the risk for neural tube defects, maternal osteomalacia, neonatal hypocalcemia and rickets, low birth weight, preterm labor, and fetal mental retardation [35]. Vitamin A can also be deficient, although it is less studied. This can lead to developmental problems with eyes and vision. One group found an 11% incidence of vitamin A deficiency among a cohort of RYGB patients [36]. Infants with vitamin A deficiency may become immunocompromised.

A Brazilian study compared the presence of vitamin A deficiency among pregnant patients who had RYGB versus normal controls. They identified that 75% of the pregnant women with a history of RYGB reported night blindness, correlating with significantly lower rates of serum retinol and β-carotene [37]. The patients were counseled to take 5000 IU of retinol orally upon documentation of pregnancy. Despite this, their serum levels remained low. Vitamin A deficiency has been shown to cause microphthalmia or anophthalmia and hypoplasia of the optic nerve and tracts. There have been documented cases of these defects in infants born to patients after RYGB who were deficient in vitamin A [38].

Other groups have evaluated the incidence of iron deficiency anemia among RYGB patients who became pregnant. The authors observed a higher incidence of iron deficiency anemia among this group (29%) [39, 40].

The post-RYGB patient is prone to thiamine deficiency secondary to duodenal exclusion. Supplementation is critical to avoiding deficiencies and the associated complications. In the pregnant female with hyperemesis gravidarum, oral intake can be significantly reduced and precipitate thiamine deficiency in these patients. There have been case reports of Wernicke's encephalopathy in the setting of hyperemesis gravidarum and recent RYGB surgery [41]. Thiamine stores can be depleted in a matter of 4 weeks without any intake, but clinical manifestations are seen within 2–3 weeks of deficiency. The sequela can be serious and irreversible. Although Wernicke's encephalopathy is classically manifested by a triad of ophthalmoplegia, ataxia, and confusion, the presenting neurologic manifestations may not be classic. A high index of suspicion must exist, and the vomiting gastric bypass patient should be given intravenous thiamine immediately.

Vomiting after RYGB is not normal and may be a manifestation of an intestinal obstruction or internal hernia. RYGB patients carry a lifetime risk of internal hernia of up to 10%. The classic symptoms of left upper quadrant pain and vomiting may be obscured during pregnancy. Unrelated abdominal pain, increased intra-abdominal pressure, displacement of the small bowel, and the gravid uterus contribute to difficulty in a timely and accurate diagnosis. Thus, a high index of suspicion must be maintained, and a bariatric surgeon should be consulted in any pregnant woman with abdominal pain and a history of bariatric surgery. There are multiple reports of internal hernias arising during pregnancy; failure to identify them early can result in bowel necrosis and maternal and fetal death [42–46]. Retrospective reviews show delays of more than 48 h significantly increase the risk of bowel ischemia and resection. These reviews also report massive bowel necrosis and ultimate maternal demise [42]. These dramatic outcomes underscore the importance of a high index of suspicion and early operative evaluation to avoid the complication of missed bowel ischemia.

In conclusion, the pregnant patient with a history of RYGB should have her vitamin levels checked routinely throughout pregnancy and be encouraged to remain compliant with supplementation. If abdominal pain or vomiting develops during pregnancy, a high index of suspicion should be maintained for complications related to RYGB, including internal hernia.

Pregnancy Following Duodenal Switch

The biliopancreatic diversion-duodenal switch (BPD-DS) is an operation which has a significant malabsorptive component. There is a high risk of protein malabsorption, fat-soluble vitamin deficiency, and B12 and iron deficiency [21, 47]. Likewise, many atypical vitamin and mineral deficiencies have been described in patients who

did not have proper intake postoperatively. Some of these include selenium deficiency, which can result in serious, but potentially reversible cardiomyopathy [48].

In light of these postoperative effects, pregnancy after BPD-DS can theoretically confer a higher risk of fetal defects. This is not necessarily borne out by the literature. There are studies demonstrating good neonatal and maternal outcomes when proper perinatal care, counseling, and support are given in the context of having had bariatric surgery [49].

There are, however, reports of vitamin A deficiency in mothers leading to congenital birth defects of the eyes, microcephaly, hypotonia, growth restriction, and renal defects [50, 51]. These defects can have devastating effects and highlight the need for close lifelong follow-up and coordinated care in the prenatal period.

Other reports exist of vitamin K deficiency in a mother and her newborn. The mother experienced significant bleeding. Her infant was hypocoagulable but asymptomatic. Supplementation with vitamin K reversed the coagulopathy, and the infant suffered no complications as a result of this deficiency [52].

Patients seeking to undergo BPD-DS should be warned of the potential for serious birth defects without appropriate follow-up and close prenatal monitoring. Preoperative counseling for the female patient of childbearing age should include a detailed discussion of the need for close follow-up and strict adherence to vitamin supplementation after surgery for life.

Conclusion

In conclusion, pregnancy may be easier to attain following bariatric surgery, as fertility is improved with weight loss. However, the post-bariatric patient does face some risks during pregnancy, including mechanical problems from the LAGB and protein and vitamin deficiency from the malabsorptive operations. The patient should be followed closely during pregnancy by both a bariatric surgeon and a maternal-fetal medicine physician to ensure that these risks are mitigated by proper medical care.

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